Curriculum Vitæ

Laurent O. JAY

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Education

At the University of Geneva, Switzerland:

- Ph.D. degree in Mathematics, 1994.
- M.Sc. degree in Mathematics, 1990.
- M.Sc. degree in Computer Science, 1990.
- B.Sc. degree in Computer Science, 1989.

Research topics and main interests

- Numerical analysis: ordinary differential equations; differential-algebraic equations; classical mechanics; symplectic integration; partial differential equations; stochastic differential equations; nonlinear (optimal) control theory; optimization; nonlinear equations; approximation theory; linear algebra; linear iterative methods.
- Scientific computing: mechanical systems; electrical systems; structural mechanics; multibody dynamics; molecular dynamics; electronic structure calculations; parallel computing.
- Artificial intelligence; robotics; neural networks.
- Statistics; operations research.

Publications

- L.O. Jay: *Specialized Runge-Kutta methods for index 2 differential algebraic equations.* Math. Comp., to appear.
- L.O. Jay: *Preserving Poisson structure and orthogonality in numerical integration of differential equations.* Comput. Math. Appl., Vol. 48, pp. 237-255, 2004.
- M. Calvo, L.O. Jay, J.I. Montijano, and L. Rández: *Approximate compositions of a near identity map by multi-revolution Runge-Kutta methods.* Numer. Math., Vol. 97, pp. 635-666, 2004.
- L.O. Jay: *Solution of index* 2 *implicit differential-algebraic equations by Lobatto Runge-Kutta methods.* BIT, Vol. 43, pp. 91-104, 2003.
- L.O. Jay: *Iterative solution of nonlinear equations for SPARK methods applied to DAEs.* Numer. Algorithms, Vol. 31, pp. 171-191, 2002.
- L.O. Jay: *A note on Q-order of convergence.* BIT, Vol. 41, pp. 422-429, 2001.
- L.O. Jay: *Inexact simplified Newton iterations for implicit Runge-Kutta methods.* SIAM J. Numer. Anal., Vol. 38, pp. 1369-1388, 2000.
- N. Biehn, S.L. Campbell, L.O. Jay, and T. Westbrook: *Some comments on DAE theory for IRK methods and trajectory optimization.* J. Comput. Appl. Math., Vol. 120, pp. 109-131, 2000.
- P.E. Gill, L.O. Jay, M.W. Leonard, L.R. Petzold, and V. Sharma: *An SQP method for the optimal control of large-scale dynamical systems.* J. Comput. Appl. Math., Vol. 120, pp. 197-213, 2000.
- L.O. Jay and T. Braconnier: *A parallelizable preconditioner for the iterative solution of implicit Runge-Kutta type methods.* J. Comput. Appl. Math., Vol. 111, pp. 63-76, 1999.
- L.O. Jay, H. Kim, Y. Saad, and J. Chelikowski: *Electronic structure calculations for plane-wave codes without diagonalization.* Comput. Phys. Comm., Vol. 118, pp. 21-30, 1999.
- L.O. Jay: *Structure preservation for constrained dynamics with super partitioned additive Runge-Kutta methods.* SIAM J. Sci. Comput., Vol. 20, pp. 416-446, 1998.
- L.R. Petzold, L.O. Jay, and J. Yen: *Numerical solution of highly oscillatory ordinary differential equations.* Acta Numerica, A. Iserles ed., Cambridge Univ. Press, Cambridge, pp. 437-484, 1997.
- L.O. Jay, A. Sandu, F.A. Potra, and G.R. Carmichael: *Improved QSSA methods for atmospheric chemistry equations.* SIAM J. Sci. Comput., Vol. 18, pp. 182-202, 1997.

- L.R. Petzold, J.B. Rosen, P.E. Gill, L.O. Jay, and K. Park: *Numerical optimal control of parabolic PDEs using DASOPT.* In "Large-scale optimization with applications", Part II: "Optimal design and control", IMA Vol. Math. Appl., L.T. Biegler, T.F. Coleman, A.R. Conn, and F.N. Santosa eds, Springer, New York, Vol. 93, pp. 271-300, 1997.

- L.O. Jay: *Symplectic partitioned Runge-Kutta methods for constrained Hamiltonian systems.* SIAM J. Numer. Anal., Vol. 33, pp. 368-387, 1996.

- L.O. Jay: *Convergence of Runge-Kutta methods for differential-algebraic systems of index 3.* Appl. Numer. Math., Vol. 17, pp. 97-118, 1995.

- E. Hairer and L.O. Jay: *Implicit Runge-Kutta for higher index differential-algebraic systems.* Contributions in Numerical Mathematics, World Sci. Ser. Appl. Anal., Vol. 2, pp. 213-224, 1993.

- L.O. Jay: *Collocation methods for differential-algebraic equations of index 3.* Numer. Math., Vol. 65, pp. 407-421, 1993.

- L.O. Jay: *Convergence of a class of Runge-Kutta methods for differential-algebraic systems of index 2.* BIT, Vol. 33, pp. 137-150, 1993.

- L.O. Jay: *Dense output for extrapolation based on the semi-implicit midpoint rule.* ZAMM, Vol. 73, pp. 325-329, 1993.

- **Ph.D. thesis:** *Runge-Kutta type methods for index three differential-algebraic equations with applications to Hamiltonian systems.* Department of Mathematics, University of Geneva, Switzerland, 1994. Advisor: Prof. E. Hairer.

- **M.Sc. thesis:** *Construction of a continuous solution for an extrapolation method: theory and practice.* Departments of Mathematics and of Computer Science, University of Geneva, Switzerland, 1990. Advisor: Prof. E. Hairer.

Technical reports, conference papers, and work in progress

- L.O. Jay: *Symplectic specialized partitioned additive Runge-Kutta methods for conservative systems with holonomic constraints.* In progress.

- L.O. Jay: *Mixed analytical/numerical and multiscale procedures for solving ordinary differential equations.* In progress.

- L.O. Jay and H. Oh: *Convergence results for SPARK methods applied to mixed systems of index* 2 *and* 3 *DAEs.* In progress.

- S.S. Shome, E.J. Haug ,and L.O. Jay: *Dual-rate integration using partitioned Runge-Kutta methods for mechanical systems with interacting subsystems.* Submitted to Mech. Structures Mach., 2003.

- L.O. Jay: *Preconditioning and parallel implementation of implicit Runge-Kutta methods.* Submitted to Appl. Numer. Math., 2002.

- Z. Mi, J. Yang, K. Abdel-Malek, and L.O. Jay: *Planning for kinematically smooth manipulator trajectories.* DETC2002/MECH-34325, Proceedings of 2002 ASME Design Engineering Technical Conferences, Montreal, Canada, 2002.

- L.O. Jay: *Lagrangian integration with symplectic methods.* AHPCRC Preprint 97-009, 1997.

- L.O. Jay, A. Sandu, F.A. Potra, and G.R. Carmichael: *Efficient numerical integrator for atmospheric chemistry.* ICIAM 95, Third International Congress on Industrial and Applied Mathematics, Hamburg, Germany, July 1995. Special Issue of ZAMM, Issue 4: Applied Sciences, E. Kreuzer and O. Mahrenholtz eds., Akademie-Verlag, Berlin, pp. 450-453, 1996.

- L.O. Jay and L.R. Petzold: *Highly oscillatory systems and periodic-stability.* AHPCRC Preprint 95-015, 1995.

Scientific presentations

- *Gauss methods, DAEs, and orthogonal integration.* Dynamical Systems on Matrix Manifolds: Numerical Methods and Applications Workshop, Dipartimento di Matematica, Universita degli Studi di Bari, Italy, May 27-28, 2004.

- *Modifications of Gauss methods for differential equations with constraints.* Numerical and Analysis Colloquium, invited presentation, Department of Mathematics, University of Basel, Switzerland, May 7, 2004.

- *Modifications of Gauss methods for differential equations with constraints.* Colloquium, invited presentation, Department of Mathematics, University of Fribourg, Switzerland, April 27, 2004.

- *Retaining superconvergence of IRK methods applied to DAEs of index 2 and 3.* International Conference on Scientific Computing and Differential Equations (SciCADE'03), Minisymposium on Applications in Mechanics, The Norwegian Institute of Science and Technology, Trondheim, Norway, June 30-July 4, 2003.

- *Runge-Kutta methods and differential-algebraic equations.* Series of lectures given at a Summer School in Geometric Integration, Special Year in Geometric Integration (SYGI), supported by the Centre for Advanced Study and the Norwegian Academy of Science and Letters, Arendal, Norway, August 19-23, 2002.

- *Geometric integration in mechanics with differential-algebraic equations and Lobatto Runge-Kutta methods.* Foundations of Computational Mathematics, Geometric Integration and Computational Mechanics workshop, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, August 5-7, 2002.

- *Approximation of near identity Poincaré maps by multi-revolution Runge-Kutta methods.* Conference on Scientific Computation, University of Geneva, Switzerland, June 26-29, 2002.

- *Preconditioning for implicit Runge-Kutta methods.* International Conference on Scientific Computation And Differential Equations (SciCADE'01), Vancouver, British Columbia, Canada, July 29-August 3, 2001.
- *Preconditioning and parallel implementation of implicit Runge-Kutta methods.* 2001 Biennial conference on numerical analysis, University of Dundee, Scotland, June 26-29, 2001.
- *Preconditioning for implicit Runge-Kutta methods.* Midwest Numerical Analysis Day, Computer Science Department, University of Illinois, Urbana-Champaign, May 12, 2001.
- *Preconditioners for the iterative solution of implicit Runge-Kutta type methods applied to ODEs and DAEs.* Auckland Numerical Ordinary Differential Equations (ANODE 2001) Workshops, Department of Mathematics, University of Auckland, New Zealand, January 8-12, 2001.
- *Iterative solution of nonlinear equations for Lobatto IRK methods applied to DAEs.* First SIAM Conference on Computational Science & Engineering, Washington DC, September 21-24, 2000.
- *Implementation issues for implicit integration methods.* Auckland Numerical Ordinary Differential Equations (ANODE99) Workshops, Department of Mathematics, University of Auckland, New Zealand, August 16-20, 1999.
- *Inexact simplified Newton iterations for implicit Runge-Kutta methods.* Also co-organizer of a minisymposium entitled *Solving linear and nonlinear systems in differential equations.* International Conference on Scientific Computation And Differential Equations (SCICADE99), Fraser Island, organized by the Department of Mathematics of the University of Queensland, Australia, August 9-13, 1999.
- *Inexact approximate simplified Newton iterations for implicit Runge-Kutta methods.* Midwest Numerical Analysis Day, Department of Applied Mathematics, Illinois Institute of Technology, Chicago, April 24, 1999.
- *Iterative solution of implicit Runge-Kutta type methods and their application in constrained dynamics.* Colloquium, LMC-IMAG, Grenoble, France, March 26, 1998.
- *A parallelizable preconditioner for the iterative solution of implicit Runge-Kutta type methods.* 2nd Meeting on Numerical Methods for Differential Equations, Department of Mathematics, University of Coimbra, Portugal, February 25-27, 1998.
- *Iterative solution of implicit Runge-Kutta type methods and their application in constrained dynamics.* Colloquium, Department of Mathematics, Southern Methodist University, Dallas, TX, February 19, 1998.
- *Iterative solution of implicit Runge-Kutta type methods and their application in constrained dynamics.* Colloquium, Department of Mathematics, Florida Atlantic University, Boca Raton, FL, February 16, 1998.

- *Iterative solution of implicit Runge-Kutta type methods and their application in constrained dynamics.* Colloquium, Center for Applied Scientific Computing (CASC), Lawrence Livermore National Laboratory, CA, February 13, 1998.
- *Iterative solution of implicit Runge-Kutta type methods and their application in constrained dynamics.* Colloquium, Department of Mathematics, University of Iowa, Iowa City, IA, February 5, 1998.
- *Numerical optimal control of PDEs using DASOPT.* Midwest Numerical Analysis Day, University of Wisconsin, Milwaukee, WI, April 27, 1996.
- *Structure-preserving integrators for Hamiltonian and mechanical systems.* Winter Seminar Series, Supercomputer Institute of the University of Minnesota, Minneapolis, MN, January 10, 1996.
- *Numerical integration and structure-preservation.* Colloquium, invited presentation, Department of Mathematics, University of Fribourg, Switzerland, June 29, 1995.
- *SPARK methods for mechanical systems.* Seminar, invited presentation, Department of Mathematics, University of Geneva, Switzerland, June 28, 1995.
- *Symplectic partitioned Runge-Kutta methods for constrained Hamiltonian systems.* Seventh Leslie Fox Prize Meeting, University of Dundee, Scotland, June 25, 1995.
- *Stiffness and highly oscillatory systems.* ODE to NODE, Workshop, Geiranger, Norway, June 19-22, 1995.
- *Structure-preserving integrators and DAEs.* SciCADE95, Minisymposium, Stanford University, CA, March 28-April 1, 1995.
- *Structure-preserving integrators for Hamiltonian and mechanical systems.* 1994 SIAM Annual Meeting, Minisymposium, San Diego, CA, July 25-29, 1994.
- *Symplectic partitioned Runge-Kutta methods for constrained Hamiltonian systems.* 15th Biennial conference on numerical analysis, University of Dundee, Scotland, June 29-July 2, 1993.
- *Partitioned Runge-Kutta methods for Hamiltonian systems with constraints.* Swiss Day in Numerical Analysis, University of Fribourg, Switzerland, April 1, 1993.
- *Convergence of Runge-Kutta methods for differential-algebraic systems of index 3.* SCADE93, University of Auckland, New-Zealand, January 4-8, 1993.

Academic awards and grants

- *Dean's Scholar Award*, March 2003, College of Liberal Arts and Sciences, University of Iowa, USA, amount: US$ 10000. Award reserved for the first time to recognize and honor a stellar promotion record (this award is usually awarded

to recognize mid-career faculty members,tenured associate professors between their third and fifth year at rank, who excel in both teaching and scholarship or creative work).

- *NSF-Faculty Early Career Development (CAREER) Program, Award No DMS-9983708*: Title of project: *Development, analysis, implementation, and application of innovative structure preserving integrators for constrained systems in mechanics*, amount: $ 200,000. Duration: June 2000-May 2005, PI.

- *NASA Award No 1210679, JPL subcontract No 1213833*: Research project with Jet Propulsion Laboratory (JPL), amount: $ 15000. Duration: November 1999-November 2000.

- *Old Gold Summer Fellowship*: College of Liberal Arts, University of Iowa, Iowa City, IA, June 1999. Summer support based on a research grant proposal.

- *50th Vacheron & Constantin Prize*: Faculty of Sciences, University of Geneva, Switzerland, April 1998. Prize awarded to the best research project in competition.

- Visiting Post-Doctoral Fellow at the Institute for Mathematics and Its Applications of the University of Minnesota, Minneapolis, MN, supported in part by a *grant for scientific research of the Holderbank Foundation, Switzerland (Holderbank-Stiftung zur Forderung der wissenschaftlichen Fortbildung)* and by the *50th Vacheron & Constantin Prize.*

- *Seventh Leslie Fox Prize Meeting*: second prize, University of Dundee, Scotland, June 1995. International award in numerical analysis for research scientists under thirty years old.

- Post-Doctoral Associate at the University of Minnesota, Minneapolis, MN, from October 1994 to September 1995 supported by a *grant in Mathematics of the Swiss National Science Foundation.*

- *Vacheron & Constantin Award*: Faculty of Sciences, University of Geneva, Switzerland, June 1994. For the best Ph.D. thesis in mathematics.

- *Marc Birkigt Award*: Collège de Saussure, Geneva, Switzerland, June 1984. For the best average in mathematics, physics, and descriptive geometry in high school.

- *Givaudan Award*: Collège de Saussure, Geneva, Switzerland, June 1984. For the best average in physics and chemistry in high school.

- *De Saussure Award*: Collège de Saussure, Geneva, Switzerland, June 1984. For the best average in mathematics and French in high school.

- *Alfred Treuthardt Award*: Cycle d'Orientation du Vuillonnex, Geneva, Switzerland, June 1980. For the best average in mathematics of all junior high schools in Geneva.

Employment

- July 2003-present: Associate Professor, August 1998-June 2003: Assistant Professor, Department of Mathematics of the University of Iowa, Iowa City, IA. Courses taught so far: Elementary numerical analysis; Optimization techniques; Calculus I; Calculus II; Numerical analysis I (nonlinear equations and approximation theory); Engineering calculus I; Numerical analysis II (differential equations and linear algebra); Topics in numerical analysis (numerical solution of time-dependent differential equations in applications, part I); Topics in applied mathematics (numerical solution of time-dependent differential equations in applications, part II).

- July 2002-present: Faculty member of the interdisciplinary Applied Mathematical and Computational Sciences PhD Program of the University of Iowa, Iowa City, IA.

- March 2004: Visiting Professor, Department of Applied Mathematics, University of Zaragoza, Spain.

- July 2003-June 2004: Visiting Professor, Departments of Mathematics and Econometrics, University of Geneva, Switzerland.

- February 2002: Visiting Professor, Department of Applied Mathematics, University of Zaragoza, Spain.

- July 2001 and January 2002: Visiting Professor, Department of Mathematics, University of Geneva, Switzerland.

- June 2001: Visiting Professor, Department of Mathematics, Lund University, Sweden.

- February 1998 to July 1998: Visiting Post-Doctoral Fellow at the Institute for Mathematics and Its Applications and at the Minnesota Supercomputer Institute of the University of Minnesota, Minneapolis, MN, in collaboration with Prof. Bernardo Cockburn.

- March and April 1998: Visiting Post-Doctoral Fellow at the Department of Mathematics of the University of Geneva, Switzerland, in collaboration with Prof. Ernst Hairer and Prof. Gerhard Wanner.

- February 1997 to January 1998: Post-Doctoral Associate at the Minnesota Supercomputer Institute and at the Computer Science Department of the University of Minnesota, Minneapolis, MN, in collaboration with Prof. Yousef Saad and Prof. Jim Chelikowski.

- October 1994 to January 1997: Post-Doctoral Associate at the Army High Performance Computing Research Center and at the Computer Science Department of the University of Minnesota, Minneapolis, MN, in collaboration with Prof. Linda R. Petzold. From October 1995 to September 1996: also Research Scholar at the Minnesota Supercomputer Institute, Minneapolis, MN.

- November 1994: Visiting Post-Doctoral Fellow at the Mathematical Department and at the Center for Global and Regional Environmental Research of the University of Iowa, Iowa City, IA, in collaboration with Prof. Florian A. Potra.
- October 1989 to September 1994: Research Assistant in Numerical Analysis and Teaching Assistant at the Department of Mathematics of the University of Geneva, Switzerland, for the following courses: dynamical systems; statistics for computer scientists; distribution theory; introduction to probability and statistics; analysis I; general mathematics II; numerical analysis of partial differential equations; numerical analysis; introduction to probability; statistics for non-mathematicians; general mathematics I.

Memberships

- Society for Industrial and Applied Mathematics (SIAM).
- American Mathematical Society (AMS).
- Mathematical Association of America (MAA).
- American Association of University Professors (AAUP).
- Swiss Mathematical Society (SMS).

Miscellaneous

- Referee for the National Science Foundation (NSF) and for professional journals including: Advances in Computational Mathematics; Applied Mathematics Letters; Applied Numerical Mathematics; BIT; Computer and Mathematics with Applications; IMA Journal on Numerical Analysis; Journal of Computational and Applied Mathematics; Journal of the Franklin Institute; Journal of Guidance, Control, and Dynamics; Journal of Nonlinear Science; Parallel Computing; SIAM Journal on Applied Dynamical Systems; SIAM Journal on Numerical Analysis; SIAM Journal on Scientific Computing; Tamkang Journal of Mathematics.
- Colloquium Chair, Department of Mathematics, University of Iowa, Iowa City, IA, academic year 1998-1999.
- Third cycle course in numerical analysis, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland, 1992-1993.
- Dale Carnegie course, 1997.
- Player in the junior Swiss national soccer team.
- Winner of the game "A vos lettres" for young people at the French-speaking Swiss Television.
- Permanent resident of the USA.
- Languages: French, English (fluent), German (good knowledge).

References

Available upon request.